Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

TRANSACTIONS
OF
American Microscopical Society
(Published in Quarterly Installments)

Vol. XXXVI APRIL, 1917 No. 2

# A MONOSTOME LUNG FLUKE FROM THE PAINTED TERRAPIN, CHRYSEMYS MARGINATA AGASSIZ

By Franklin D. Barker and Susanne Parsons

With plates VI and VII

## Synopsis

Introduction ........ 55
Technique ........ 56
Morphology of Trematode ........ 57
Taxonomy ........ 62
Papers cited ........ 65
Explanation of Plates ........ 65

## Introduction

The trematode here described was first found in August, 1911, by the senior author in the lungs of the painted terrapin, *Chrysemys marginata* Agassiz, taken from Lake Emily, a small lake near St. Peter, Minnesota. A preliminary study of the parasite was made at that time, and subsequently this material was turned over in September, 1913, to the junior author, who in collaboration with the senior author has made a detailed study of the parasite.

---

Studies from the Zoological Laboratory, The University of Nebraska, No. 116

## TECHNIQUE

During August and September of the summer of 1911, seven turtles of the species *Chrysemys marginata* Agassiz, were secured from Lake Emily. Upon examination of the lungs it was found that two of these turtles were uninfected, while of the remaining five, one yielded 13 trematodes from both lungs, one yielded 1 from one lung, a third and fourth 5 and 3 respectively, and the fifth yielded 3 from one lung. Later, during the months of November and December of the same year, sixteen more turtles from the same lake were examined with the result that only one showed a parasitic infection of the lungs and only one trematode was obtained. It may be stated, however, that these turtles had been kept in confinement from one to two months, which together with the time of year, may account for the small percentage of infection.

Two years later, during the fall of 1913, seven turtles of the same species were obtained from the Fairport U. S. Biological Station, near Fairport, Iowa, on the Mississippi River. The lungs of these seven turtles were examined and it was found that two, one male and one female, were uninfected, and of the remaining five, two had both lungs infected, both being male animals and furnished three and six trematodes respectively. Of the three having one lung infected, one female and one male furnished one trematode each, while the third, a female yielded thirteen trematodes, four of which were together in one pocket of the lung. The minimum number of trematodes obtained from a single turtle was one, and the maximum number thirteen. The three male turtles furnished a total of ten trematodes, and the two female turtles furnished a total of sixteen trematodes, showing the females almost three times as heavily infected as the males. Possibly different habits or food eaten may have a bearing on this difference in the degree of infection. This same species of turtle secured from the creeks and ponds near Lincoln, Nebraska, has never been found to harbor these trematodes.

To kill the trematodes, the specimens were compressed between slides, thus keeping the worm in a fairly well distended condition, and hot solutions of alcoholic-corrosive-acetic, Zenker's, Bouin's or lacto-phenol, were run between the slides. The toto-mounts and sections were stained in borax carmine, Le Brun's, and Delafield's hæmatoxylin.

For the study of the eggs, worms which had been killed in lacto-phenol or Bouin's solution were teased up in those solutions and the eggs isolated, thus insuring the least shrinkage and distortion of the eggs.

## Morphology

The description given is based on the comparative study of fifteen specimens mounted in toto, and ten series of sections cut longitudinally, transversely, and sagittally.

The worms were, when living, a reddish brown, with a thick fat elongated body which curled ventrad, along the long axis. In one specimen the intestinal ceca were observed to be a bright blood-red color, indicating that the worms feed upon blood in the lung. The uterine coils at each side of the body in all specimens were dark, and the longitudinal, straight tubes of the uterus were especially black, due to the presence of dark granules. All specimens were characterized by a marked sluggishness.

The worms vary in length from 12.24 mm. to 4.899 mm., the mode being 9.5 mm. for 43 per cent. The width at the widest part of the body varies between a maximum of 2.65 mm. and a minimum of 1.57 mm. The body is widest at the level of the second anterior fifth, and tapers gradually toward the posterior end, which is rounded. From this same level the body tapers anteriorly more rapidly and the extreme anterior end is decidedly pointed (Plate VI, figs. 2 and 6). With the exception of the two ends the sides of the body are almost parallel and the dorso-ventral flattening is marked. Strong circular bands of muscle fibers run around the body at regular intervals, giving it a segmented appearance when contracted. The oral sucker, the only one present, is sub-terminal in position and is a globular fleshy structure, relatively small but distinct. Its musculature is conspicuously weak, it being composed mostly of parenchyma tissue. (Plate VII, fig. 3.) The length of the oral sucker varies between a maximum of 0.314 mm. and a minimum of 0.204 mm., the mode being 0.245 mm. for 56 per cent. The width of the sucker varies from a maximum of 0.455 mm. to a minimum of 0.314 mm., the mode being 0.435 mm. for 54 per cent.

Just posterior and very close to the oral sucker is the pharynx, a very muscular and almost globular structure, formed by two bean shaped halves. The pharynx varies in length from a maximum of 0.345 mm. to a minimum of 0.219 mm., the mode being 0.314 mm. for 44 per cent. The width of the pharynx varies between a maximum of 0.314 and a minimum of 0.219 mm., the mode being 0.282 mm. for 44 per cent.

The pharynx is followed by a very short, wide esophagus. Its modal length is 0.047 mm. and its modal with 0.143 mm. It was impossible to determine its length and width in all specimens, due to a contracted condition but these measurements were fairly constant.

Immediately posterior to the esophagus, the digestive tube branches into two wide intestinal ceca, which pass posteriorly as straight unbranched tubes to within 0.282 mm. of the posterior end of the body where they end blindly. The ceca occupy from one-fifth to more than one-half of the width of the body, leaving only a small space between them in the median line of the body. In all the specimens examined clots of blood or mucous from the lungs of the turtle were found in the intestinal ceca.

*Female genitals:* A well-defined ovoidal ovary lies in a dorsal position slightly posterior to the bifurcation of the intestine and to the right or left of the median line. Its length varies from 0.392 mm. to 0.518 mm. the mode being 0.44 mm. for 57 per cent. Its width varies from 0.314 mm. to 0.455 mm., the mode being 0.35 mm. for 70 per cent. Its margin is smooth. A small ciliated oviduct leads caudad from the posterior margin of the ovary and after making several close coils joins the vitelline duct. The union of these two ducts marks the beginning of the uterus which after making several compact turns dorsal to the testis and caudad to the ovary turns to the left or right just caudad to and across the base of the ovary and passing posteriorly enters a well defined and compact shell gland about one-fourth to one-half the size of the ovary and situated obliquely caudad to the ovary (Plate VI, fig. 4.) The uterus may be divided into two parts, the coiled lateral portion, extending from the level of the ovary to the posterior end, lying along the sides of the body and extending mesad over the intestinal ceca and the arms of the vitellarium and the straight median portion extending from the posterior end to the genital pore. After emerging from the shell gland the uterus takes the following course in loose coils dorsal to the vitellarium, posteriorly to the level of the anterior third of the body and just caudad to the seminal vesicle then in a straight course transversely and obliquely ascending across the body dorsal to the intestinal cecum to the level of the ovary, then in descending coils along that side of the body to the posterior end obliquely across to the opposite side of the body and in ascending lateral coils to the level of the bifurcation of the intestine where it turns mesad and in a straight course passes to the posterior end of the body in the median plane then turning back on itself ascends in a straight course parallel and ventral to the descending limb to the common genital pore just ventral to the posterior margin of the oral sucker.

The lateral uterine coils are less numerous and smaller in the younger worms while the median straight tubes are larger than in the older worms in which the lateral coils are numerous and compact and the median tubes narrow. The lateral coils are crowded with developing eggs while the median straight portions contain comparatively few dark colored eggs. Masses of sperm cells are found all along the course of the uterus but are most abundant in the terminal portions, near the ovary and the genital pore.

The eggs are very abundant in the coiled lateral portions of the uterus but few are found in the median portion. Those in the median portion are fully mature and are dark brown in color. They are egg-shaped, one end being slightly more pointed than the other. The shell is thin and no operculum could be found. They vary in length from 0.045 mm. to 0.065 and in width from 0.022 mm. to 0.030 mm. The largest eggs are found in the smaller worms. (Plate VI, fig. 5.)

The vitellarium is a voluminous "U" shape organ with its apex or closed end at the level of the anterior fourth or sixth of the body just posterior to the ovary. The two arms are lateral in position and lie dorsal to the uterine coils and the intestinal ceca. They are somewhat coiled and extend to the posterior seventh or ninth of the body. From the posterior half of each arm a vitelline duct arises and passing ventrad around the outside of each intestinal ceca passes cephalad under or mesad to the ceca to the level of the apex of the vitellarium where they turn mesad and unite to form a small yolk reservoir posterior to the ovary and just anterior to the apex of the vitellarium. A short vitelline duct passes anteriorly in the median line and joins the oviduct just caudad to the ovary. Neither a Laurer's canal nor a seminal receptacle is present.

*Male genitals:* In the older, larger worms, 6 to 12 mm. long, a testis is not discernable but in the smaller worms, 3.5 to 6 mm. long, a single spherical or ovoidal testis with smooth margin, one-half to one-fourth as large as the ovary, is present, lying ventral to and partly under or just posterior to the ovary. The testis is often obscured by the first compact coils of the uterus which lie dorsal to it. A small duct, the vas deferens, leads dorsad from the anterior end of the testis and enters a well defined ovoidal and comparatively large prostate gland which lies dorsal to the testis. (Plate VII, fig. 4.) The vas deferens emerges from the prostate gland and passing caudad and ventral to the transverse portion of the vitellarium enters the seminal vesicle. The seminal vesicle is a prominent, wide, fish-hook shaped structure, extending from the genital pore in an undulating median course to the posterior margin of the anterior third or fourth of the body. The short arm of the vesicle lies dorsal to the long arm. The seminal vesicle merges without demarcation with the lumen of an eversible non-muscular cirrus formed by an introvert of the outer body wall of the worm. The cirrus evaginates thru a common genital pore which lies ventral and slightly lateral to the median line at the outer margin of the oral sucker. (Plate VI, fig. 1.)

We seem to have in this trematode a protandric condition in which both female and male genitals are fully developed in the younger (smaller) worms but the testis gradually atrophies and entirely disappears in the older (larger) worms. Coincident with this disappearance of the testis, the seminal vesicle increases in size and becomes distended with sperm cells and the uterine coils and the number of eggs increase enormously in volume.

Looss ('02:676) describes a similar condition in the genus *Microscaphidium,* except that the ovary atrophies also, as follows: "Die einzige Frage, auf die ich zur Zeit noch keine Antwort zu geben vermag, ist die, warum die Angehörigen der Gattung *Microscaphidium* allein von allen mit ihnen zusammen in demselben Wirthe lebenden Parasiten im Laufe von Monaten und unter allem Anscheine nach günstigen Verhältnissen nicht zur Production von Eiern schreiten. In dieser Zeit werden sie natürlich älter, und eskommt hierbei nun thatsächlich vor, dass die Keimdrüsen ganz oder theilweise atrophiren, ehe sie überhaupt in Function getreten sind. Unter den im Monat October gesammelten grössten Exemplaren von *M. reticulare* und *aberrans* fanden sich versehiedene, die in ihren Bewegungen und ihrem ganzen übrigen Verhalten genau so lebhaft waren wie ihre Genossen, deren Hoden aber dadurch auffielen, dass in ihnen eine grössere Anzahl orange-bis-ockergelber Tröpfchen und Kugeln einer speckigen, stärker lichtbrechenden Substanz enthalten waren. Nachdem die Thiere in Alkohol conservirt, gefärbt und eingeschlossen waren, zeigte sich, dass mit der Zunahme dieser Kugeln eine auffällige Abnahme der zelligen Elemente der Hoden Hand in Hand ging. Bei einem Individuum bei dem dieser Degenerationsprocess der Hoden am weitesten fortgeschritten war, fanden sich im hintern Hoden überhaupt keine gefärbten zelligen Elemente mehr, im vordern nur noch enige wenige, in beiden dagegen eine grosse Menge der erwährten Kugeln und Schollen. Die Samenblase zeigte vollkommen das Aussehen, welches sie darbietet, ehe sie in Function tritt. Im Keimstock fanden sich zwischen den normalen jugendlichen Eizellen hier und da gelbe, krümlige Massen, die in den Hoden die Anfangsstadien in der Bildung der gelben Kugeln darstellen."

Self fertizilation is of common occurrence if not the only method as shown by several specimens in which the cirrus is found extruded and inserted into the vagina or metraterm of the same individual (Plate VII, fig. 3.).

*Excretory system*: The main system consists of two lateral canals first noticeable in cross sections, about the level of the esophagus running posteriorly, just mesad and ventral to the intestinal ceca, for two-thirds the length of the body, where they empty into a large median irregular excretory bladder or reservoir. The reservoir is dorsal in position and extends from the middle of the body posteriorly to the end of the intestinal ceca where it ends blindly. The bladder opens through the excretory pore in the median line on the dorsal surface just anterior to the posterior end of the body (Plate VI, fig. 3.). The nervous system is of the typical trematode type consisting of two ganglia one on each side of the pharynx and connected by a dorsal supra-pharyngeal commisure. Two lateral nerve trunks, ventral in position, extend from the ganglia to the posterior end of the body. (Plate VII, figs. 2, 5, 6.)

## TAXONOMY

Several systematists, Looss ('02:254), Lühe ('09:24), Kossack ('11:491), Skrjabin ('13:90) have given schemes of classification for the monostome trematodes. Of the families suggested by these authors, the characters of this trematode from the lung of the terrapin conform most nearly to characters of the family *Cyclocoelidae* of Kossack ('11:496) which he describes as follows: "Digenetische Trematoden, von grossem bis mittelgrossem Körper, ohne Mundsaugnapf. Bisweilen ist ungefähr an der Grenze des ersten Körperdrittels ein Bauchsaugnapf vorhanden. Haut beim konservierten Tiere mit zahllosen Grübchen versehen. Mundöffnung endständig oder subterminal. Der verschieden, aber nie erheblich lange Öesophagus besitzt einen muskulösen Pharynx von wechselnder Grösse, dessen relativ Entfernung von der Mundöffnung schwankt. Darmschenkel einfach oder an der Innenseite mit kurzen Blindsäcken versehen, im Hinterende des Körpers bogenförmig ineinander übergehend. Excretionsporus kurz vor dem Körperende auf dem Rücken. Excretionsblase zwischen Darmbogen und dem Körperende. Genitalporus median, nicht weit hinter der Mundöffnung.

Copulationsorgane vorhanden, aber wenig kräftig entwickelt. Samenblase im Cirrusbeutel. Dotterstöcke zwischen Körperwand und den Darmschenkeln gelegen, letztere bisweilen umspannend und in diesem Falle im Hinterende wie sie kontinuierlich ineinander übergehend. Geschlechtsdrüsen zwischen den Darmschenkeln. Die beiden Hoden einfach oder gelappt schräg zueinander gelagert. Keimstock immer ganzrandig. Laurer'scher Kanal und Receptaculum seminis fehlen. Uterus sehr stark entwickelt, mit regelmässigen quer gerichteten Schlingen den Körper fast vom Hinterende bis zur Darmgabelung erfüllend. Eier sehr zahlreich, von nicht einheitlichem Aussehen, ohne Polfäden. Sie nehmen im Laufe der Entwicklung an Grösse zu und enthalten schon im Uterus das ausgebildete Miracidium, dessen doppelter Augenfleck ihnen ein charakteristisches Aussehen verleiht."

It is evident, however, that the trematode here described differs from the family *Cyclocoelidae* in several essential characters such as the presence of an oral sucker, the anterior position of the ovary, the single testis, the form and position of the vitellarium and the extent and form of the uterus. But rather than resort to the questionable procedure of creating a new family or even a sub-family based on a single new genus we prefer for the present to enlarge the characters of the family *Cyclocoelidae* as given by Kossack so that it may contain this new genus. However, a comparative study of the genera in the family *Cyclocoelidae* as given by Kossack '11 and Skrjabin '13 clearly shows that none of them will accommodate this trematode, this necessitates the creation of a new genus which we in a previous paper, Barker and Parsons ('14:193) have designated as *Aorchis* (without testis). This new species of lung fluke from the terrapin has previously been designated as *Aorchis extensus* (voluminous uterus) and becomes the type species of the genus *Aorchis* having the following characters.

Genus *Aorchis* Barker and Parsons.

Body medium to large size, slightly tapering toward the anterior and posterior ends, posterior end rounded. Oral sucker small, weak but distinct. Mouth opening terminal. Pharynx strongly muscular, without pockets. Esophagus short. Intestine composed of two simple blind sacs, not uniting at the posterior end. Genital pore not prominent, ventral to the pharynx, close to oral sucker. Ovary anterior between intestinal ceca. Shell gland compact, posterior to, and smaller than ovary. Uterus made up of coils which fill the body lateral to and overlap the intestinal ceca, extending from level of the ovary to posterior end of the body and two straight and parallel uterine tubes which pass anteriorly up the median axis of the body between the intestinal ceca. Vitelline gland a voluminous, coarse, compact, U shaped mass posterior to ovary and dorsal to the intestine, with the closed portion at anterior end. Protandrous. Testis absent, or atrophied in old worms. A single ovoidal testis present in young worms, anterior, caudad to ovary. Prostate gland near testis, seminal vesicle, a large tubular structure extending from genital pore to the level of the second anterior fifth of the body. Protrusible non-muscular cirrus present. Laurer's canal and seminal receptacle absent. Eggs without lids. Excretory pore posterior dorsal.

Type species: *Aorchis extensus* Barker and Parsons.

Habitat—Lungs of painted terrapin *Chrysemys marginata* Agassiz.

Distribution—Illinois, Iowa and Minnesota, U. S. A.

We wish to acknowledge our indebtedness to Doctor Robert E. Coker, formerly Director of the U. S. Biological Station, Fairport, Iowa, for assisting us in securing material for this study and in granting both authors the use and facilities of the Station Laboratory during the summers of 1913 and 1915.

## PAPERS CITED

BARKER, F. D. and PARSONS, SUSANNE
1914. A new species of Monostome from the Painted Terrapin, Chrysemys marginata. Zool. Anz. V. 45. No. 5. pp. 193-194.

KOSSACK, WILLY
1911. Ueber Monostomiden. Zool. Jahrb. Syst., V. 31, pp. 490-590.

LOOSS, A.
1902. Üeber neue und bekannte Trematoden aus Seeschildkröten. Zool. Jahrb. Syst., V. 16, pp. 524-694.

LÜHE, MAX.
1909. Parasitische Plattwürmer, in Brauer, Die Süsswasserfauna Deutschlands. V. 17, p. 24.

SKRJABIN, K. I.
1913. Tracheophilus sisowi n. g., n. sp. Ctrbl. Bakt., Abt. V. 69, pp. 90-95.

## EXPLANATION OF PLATES

All drawings were made with the aid of a camera lucida

### ABBREVIATIONS

| | | | |
|---|---|---|---|
| C, | Cirrus | PG, | Prostate gland |
| EC, | Excretory canal | SG, | Shell gland |
| EP, | Excretory pore | Sp, | Sperm mass |
| ER, | Excretory reservoir | SV, | Seminal vesicle |
| G, | Ganglion | T, | Testis |
| GP, | Genital pore | Ut, | Uterus |
| I, | Intestine | V, | Vitellarium |
| N, | Nerve | Va, | Vagina |
| OS, | Oral sucker | VD, | Vitelline duct |
| Ov, | Ovary | Vd, | Vas deferens |
| Ph, | Pharynx | | |

## PLATE VI

Fig. 1. Anterior end, ventral aspect; mass of sperm issuing from genital pore.

Fig. 2. *Aorchis extensus* Barker and Parsons, ventral aspect of small individual.

Fig. 3. Excretory system from reconstruction.

Fig. 4. Details of genitals from toto mount, dorsal aspect.

Fig. 5. Egg.

Fig. 6. *Aorchis extensus* Barker and Parsons, ventral aspect of large individual.

## PLATE VII

Fig. 1. Sagittal section of anterior end, showing relation of female genitals.

Fig. 2. Cross section of body thru ovary, anterior to the testis.

Fig. 3. Frontal section of anterior end showing self fertilization.

Fig. 4. Sagittal section showing relation of male genitals.

Fig. 5. Cross section of body thru pharynx.

Fig. 6. Cross section of body thru testis and shell gland, posterior to the ovary.

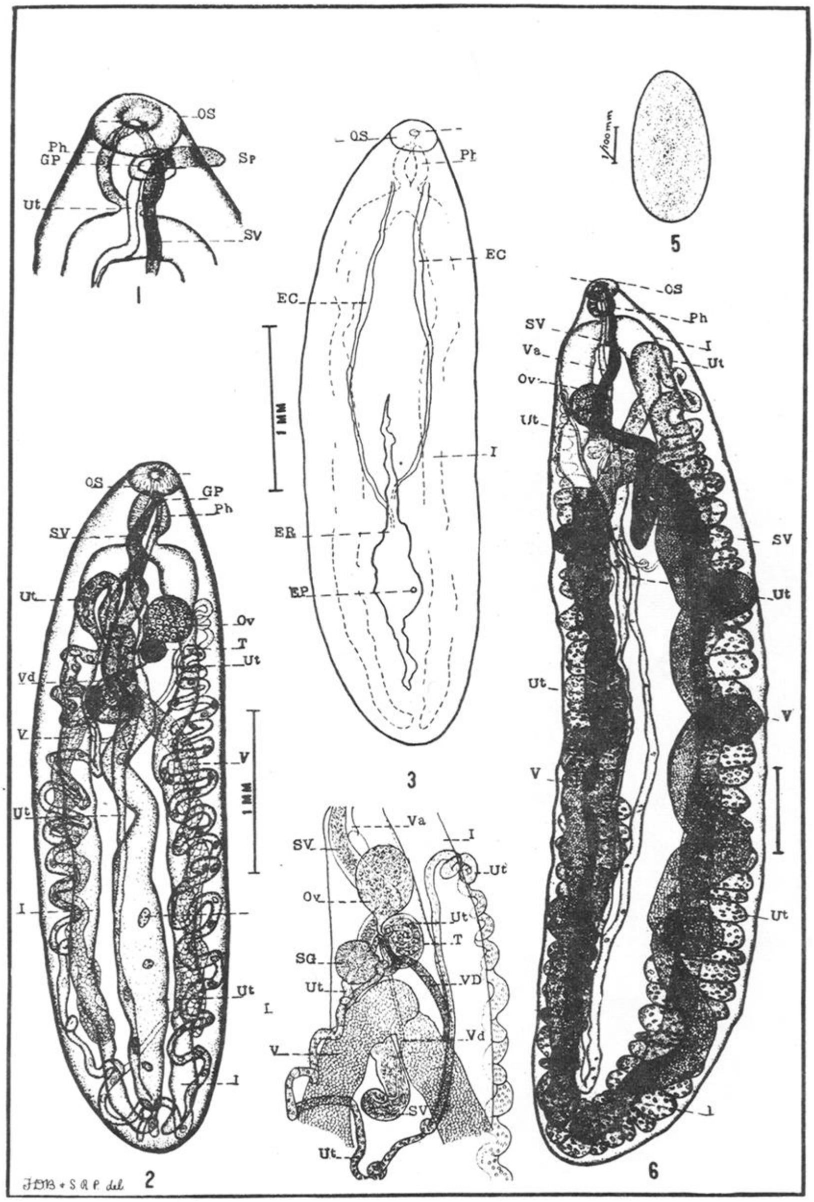
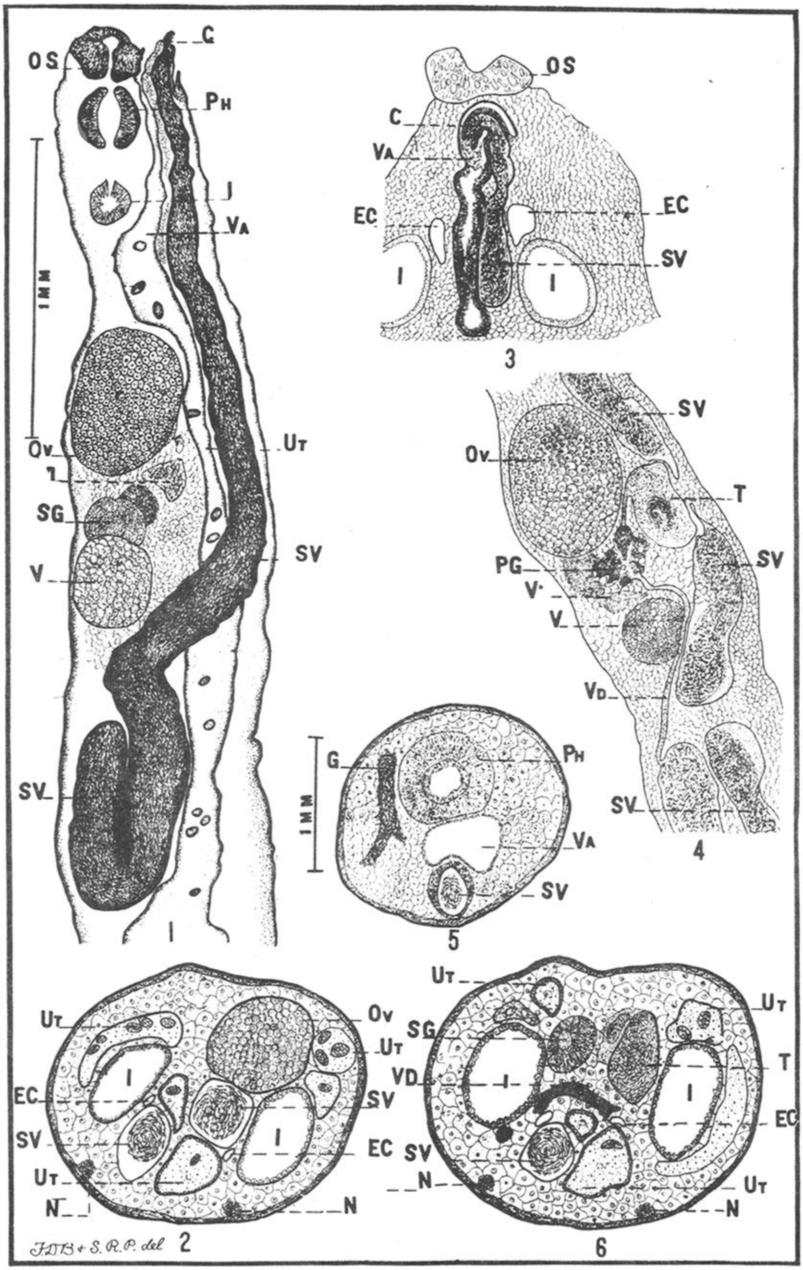

OS
Ph
GP
Sp
Ut
SV
1
OS
GP
Ph
SV
Ut
Ov
T
Ut
Vd
V
V
1 MM
Ut
I
Ut
I
JDB + SRP del
2
OS
Ph
EC
EC
1 MM
I
ER
EP
3
Va
I
SV
Ut
Ov
Ut
T
SG
VD
Ut
I
Vd
V
SV
Ut
1/100 mm
5
OS
Ph
SV
I
Va
Ut
Ov
Ut
SV
Ut
Ut
V
V
Ut
I
6

Plate VI



OS
C
PH
1MM
J
VA
OV
UT
T
SG
SV
V
SV
1
I
OS
C
VA
EC
EC
SV
I
I
3
SV
OV
T
PG
SV
V'
V
VD
SV
4
G
PH
1MM
VA
SV
5
UT
OV
UT
I
EC
SV
SV
I
EC
UT
N
N
2
UT
UT
SG
VD
I
T
I
EC
SV
N
UT
N
6
FDB + S.R.P. del

Plate VII